CAESAR systems

Module for state

David Leal

CAESAR Systems Limited

david@cedarlon.demon.co.uk

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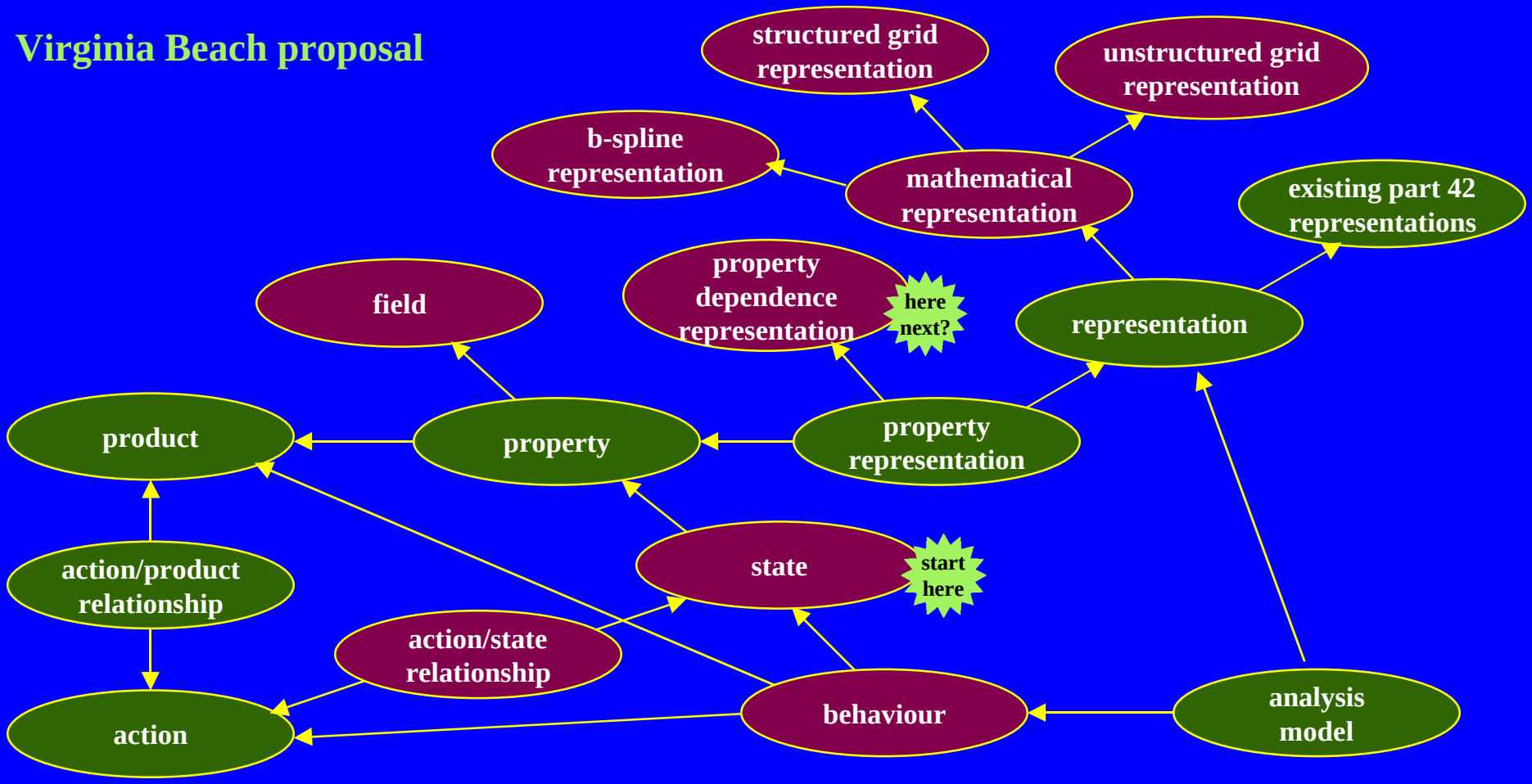
Modules for engineering analysis

Virginia Beach proposal



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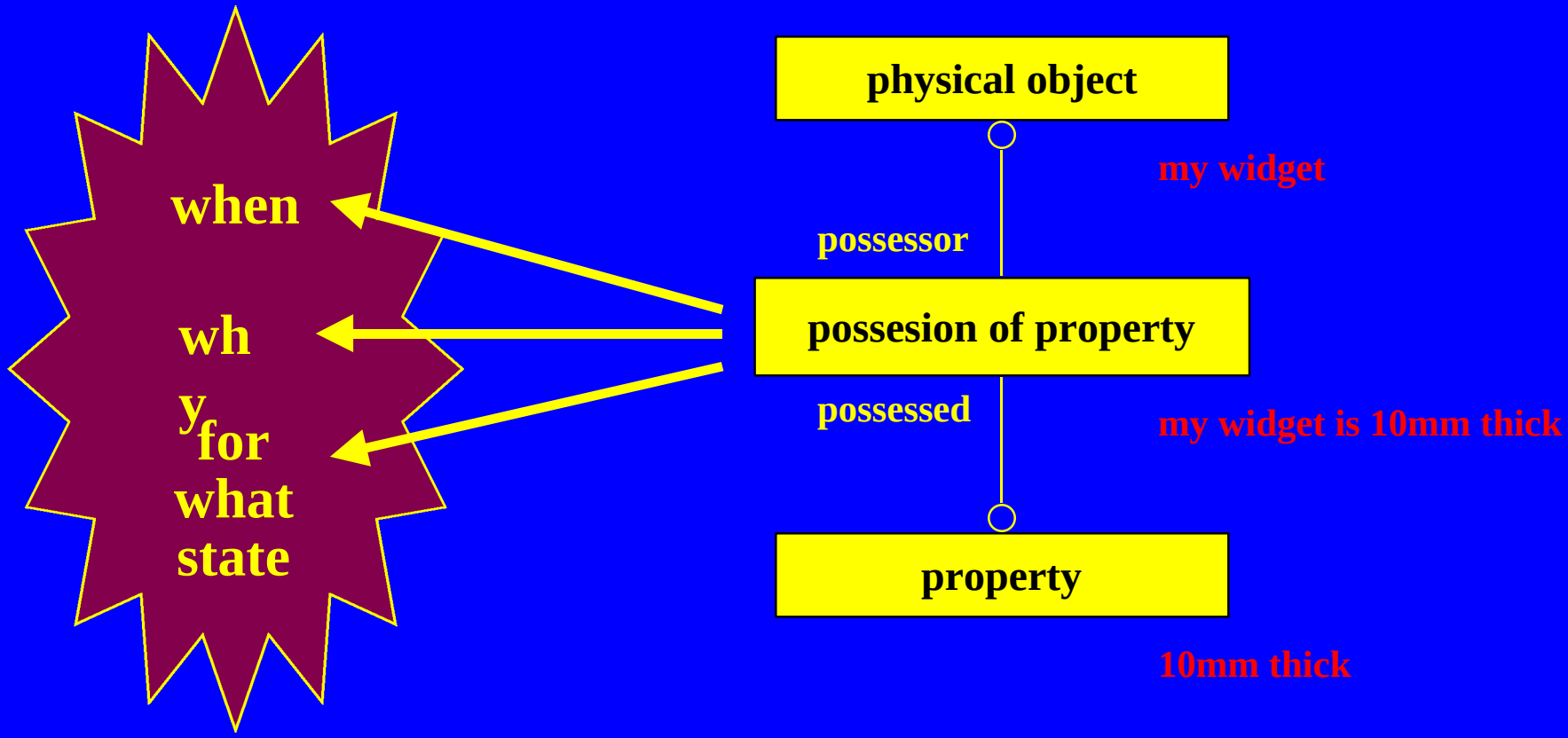
The GEM starting point



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A property

‘Widget type XYZ has a wall thickness of between 10.1mm and 9.9mm’

- **Each individual of widget type XYZ has a wall thickness that is a particular value between 10.1mm and 9.9mm**

So:

- **Each individual intended to be of widget type XYZ is measured after manufacture, and if it does not have a wall thickness between 10.1mm and 9.9mm then it is rejected**

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Throughout its lifetime?

‘Widget type XYZ has a wall thickness of between 10.1mm and 9.9mm’

- **Each individual of widget type XYZ has a wall thickness that is a particular value between 10.1mm and 9.9mm**

So:

- **Each individual assumed to be of widget type XYZ is measured from time to time, and if it is found to have a wall thickness that is not between 10.1mm and 9.9mm then it looses its classification**

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Statement about a class

'Widget type XYZ has a wall thickness of between 10.1mm and 9.9mm'

- **Widget type XYZ is a class (or set) of physical objects**
- **Each member of widget type XYZ is also a member of the class (or set) of all physical_objects with a wall thickness between 10.1mm and 9.9mm**

When is the statement true - always, when supplied, when installed, when hot, when cold?

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Statement about an individual

'Widget serial number 1234 of type XYZ has a wall thickness of between 10.1mm and 9.9mm'

- **Widget serial number 1234 is an individual that is a member of the class (or set) that is widget type XYZ**
- **Widget serial number 1234 has a particular wall thickness value, that has been measured and is known to lie within 10.1mm and 9.9mm**

When and how was widget measured, and what was the condition of the widget when measured - hot or cold?

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Property 'possession' by class

- **State criterion for class membership tested for a state**
  - » **e.g. If the criterion is met on delivery, then an individual is a member of the class throughout its life**

start here

- **Lifetime criterion for class membership**
  - » **An individual is a member of the class if the criterion is met.**
- **Predicted consequence of class membership**
  - » **It is predicted that an individual of the class has a property value in a specified range**
  - » **A prediction can have a probability**

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Class and individual

class	
generic	ac induction motor explosion-protected ac induction motor 3-phase expl-prot cage induction motor
manufactured type	TIKK-FBK3XX-4P-90kW-400V-50Hz
occurrence	XYZ/M-101 in packaged unit type XYZ
individual	
hypothetical	typical TIKK-FBK3XX-4P-90kW-400V-50Hz for stress analysis typical XYZ/M-101 with nominal properties defined for the simulation of unit type XYZ
planned	XYZ/M-101/01_123 planned completion on 2001-01-12
actual	XYZ/M-101/98_456 actually completed on 1998-11-30

specialisation

membership

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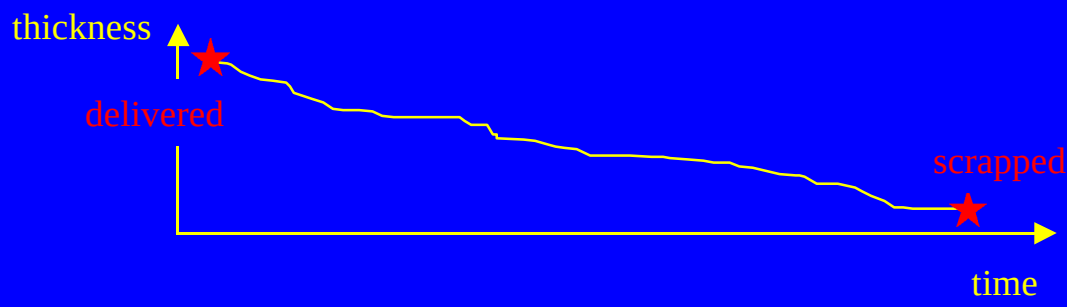
Life of an individual widget of type XYZ

individual physical object

widget serial no. 1234

thickness history



state

widget serial no. 1234 as delivered
widget serial no. 1234 as scrapped

thickness

10.05mm
9.64mm

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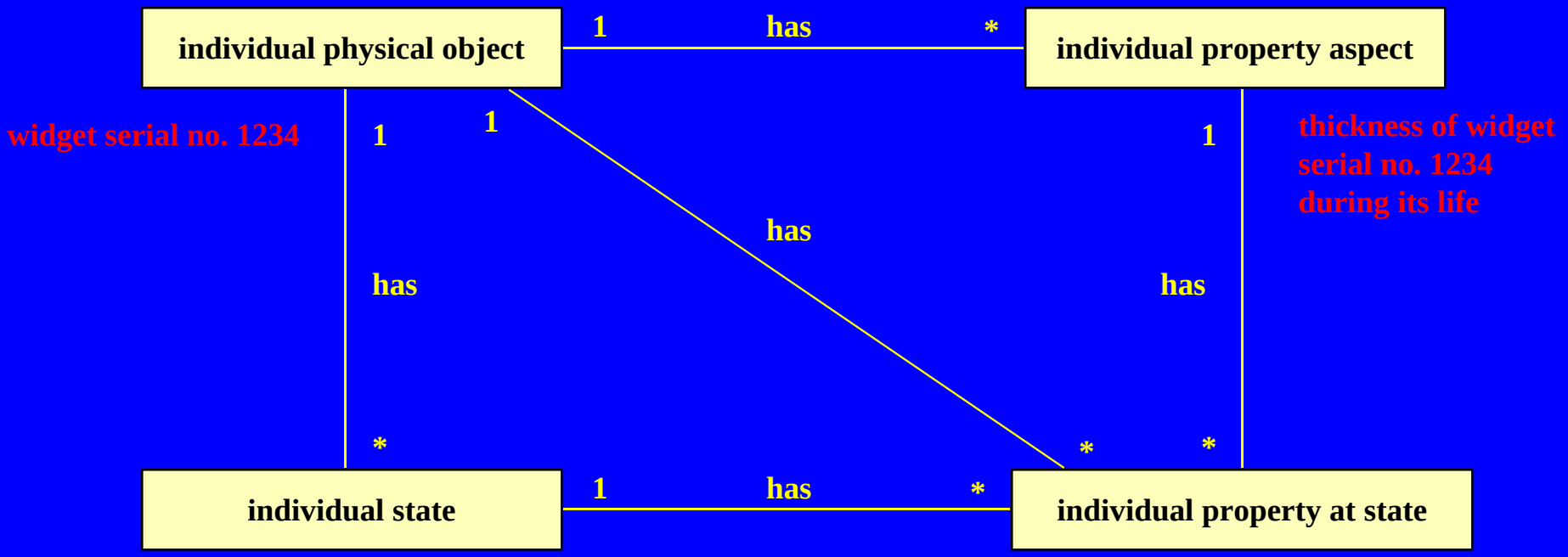
Application objects for an individual widget



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State criterion for class membership

specific statements:

- **Each individual physical object of class widget XYX has an individual state of class widget XYZ as delivered**
- **Each individual state of class widget XYX as delivered has an individual property at state of class widget XYZ between 10.1mm and 9.9mm thick as delivered**

relationship with base concepts:

- **Each individual state of class widget XYX as delivered is also of class *as delivered***
- **Each individual property at state of class widget XYZ between 10.1mm and 9.9mm thick as delivered is also of class *between 10.1 and 9.9mm thick***

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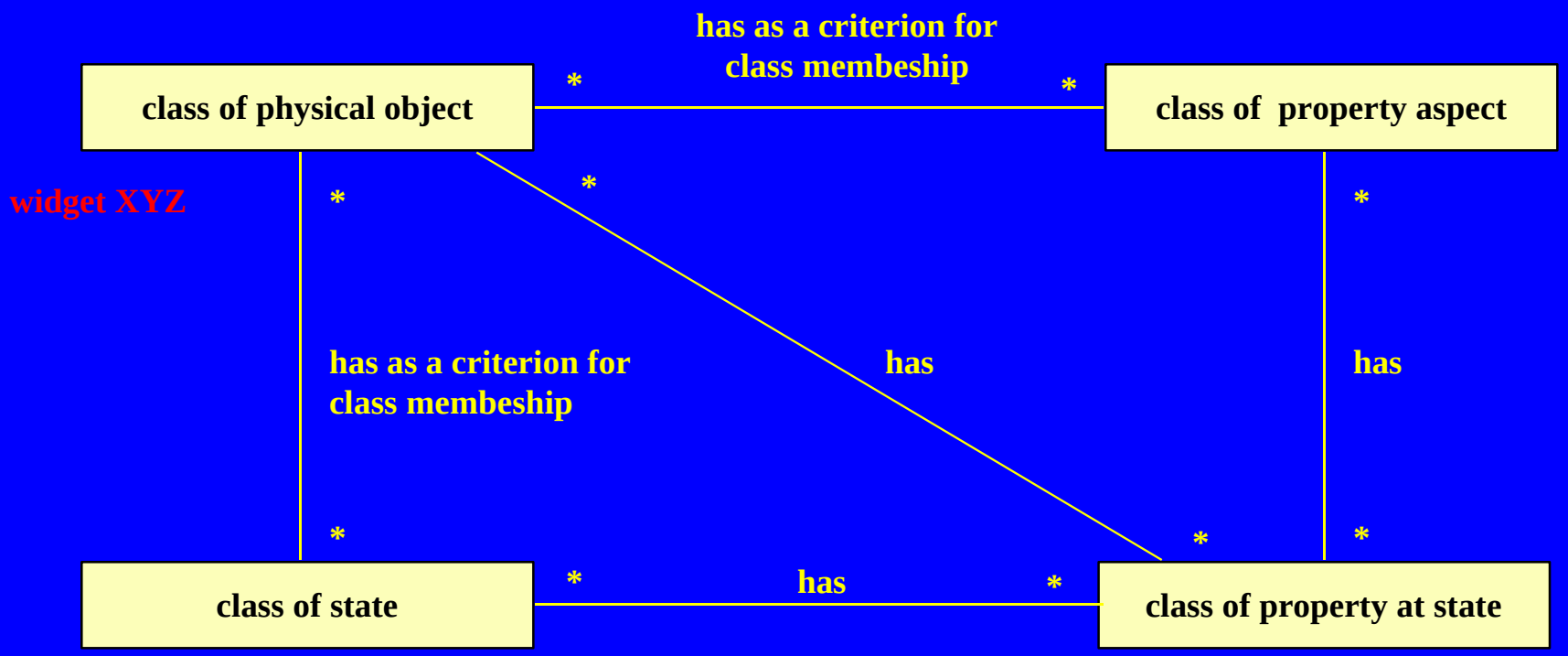
Application objects for a class of widget



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State and property

- An **individual whole state** is the composition of ***all*** the observable quantities that exist together at an instant
- An **individual state aspect** is an ***arbitrary composition of one or more*** observable quantities that exist together at an isntance and that is useful for a particular purpose
- An **individual property at state** is a ***single*** observable quantity that exists at an instant

Similar concepts with a composition relationship between them

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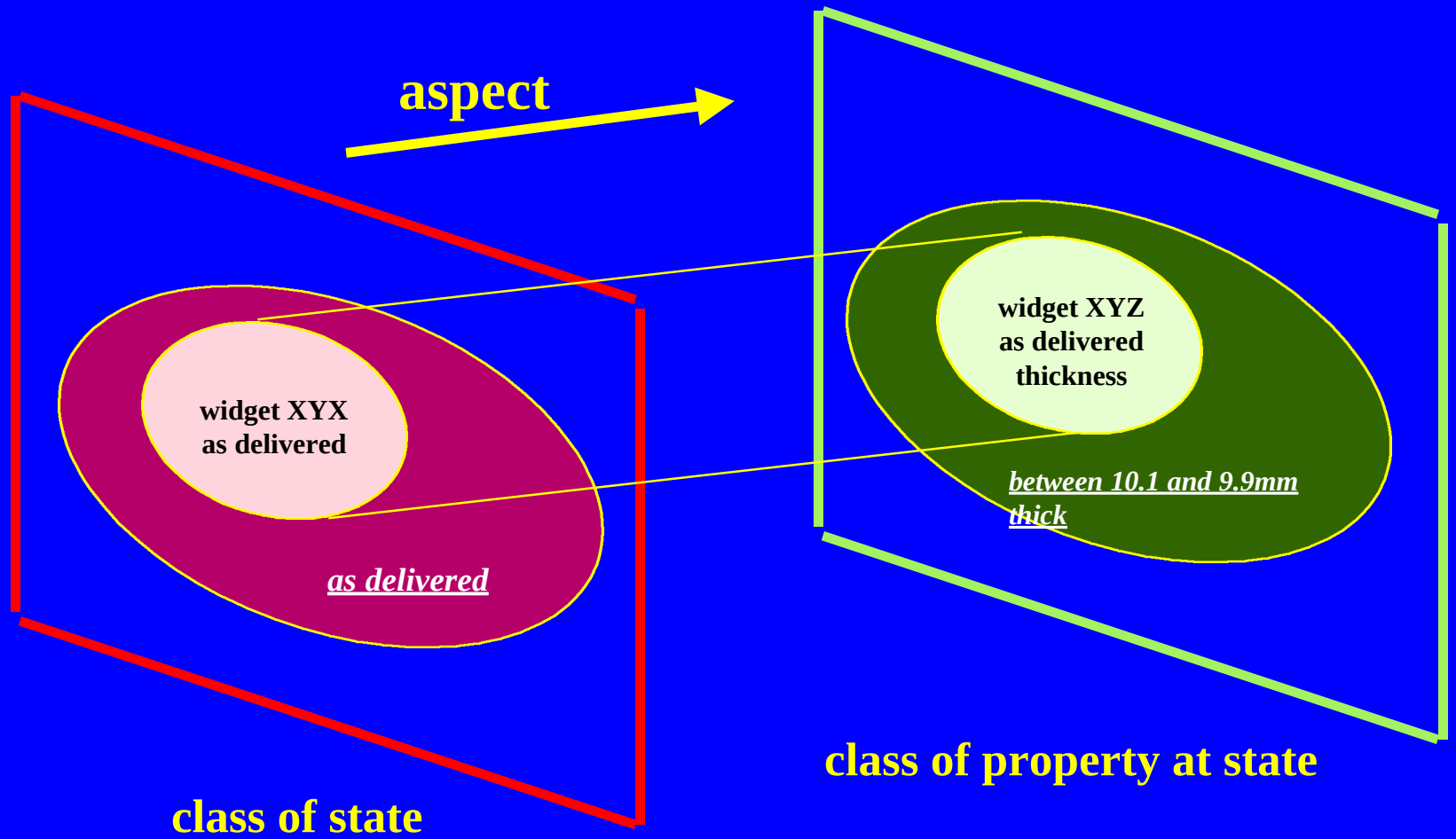
Precise semantics



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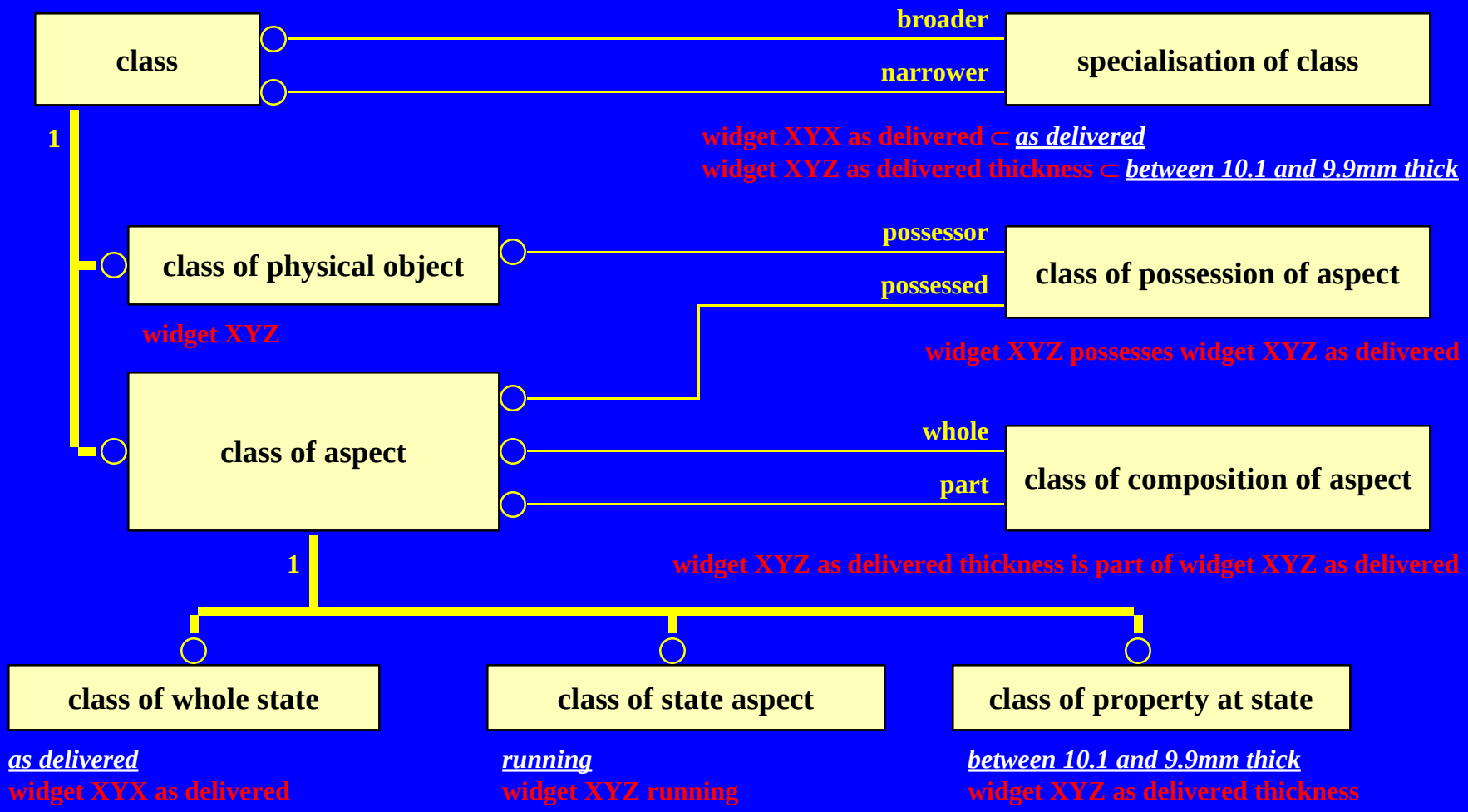
Conceptual model



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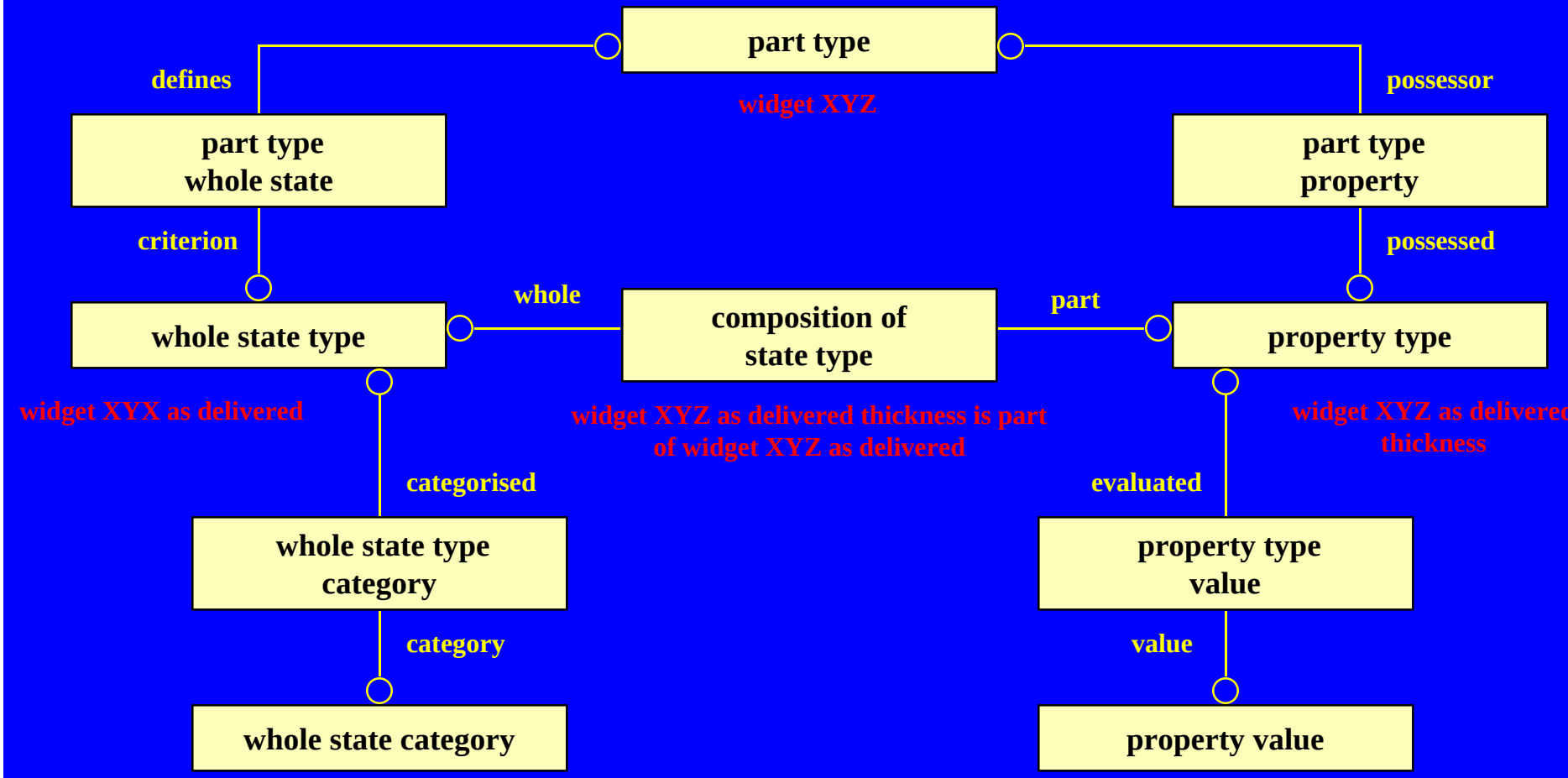
ARM model for state definition



as delivered

between 10.1 and 9.9mm thick

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Mapping - 1

conceptual	ARM	IR
class of physical object	part type	product definition
class of property at state	property type property value	property definition general property
class of whole state	whole state type whole state category	state definition state category
class of state aspect	partial state type partial state category	state definition state category

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Mapping - 2

conceptual	ARM	IR
specialisation of class	property type value state type category	general property association state definition category
class of composition of aspect	composition of state type	composition of state definition
class of possession of aspect	part type property part type whole state	product definition.definition product definition state

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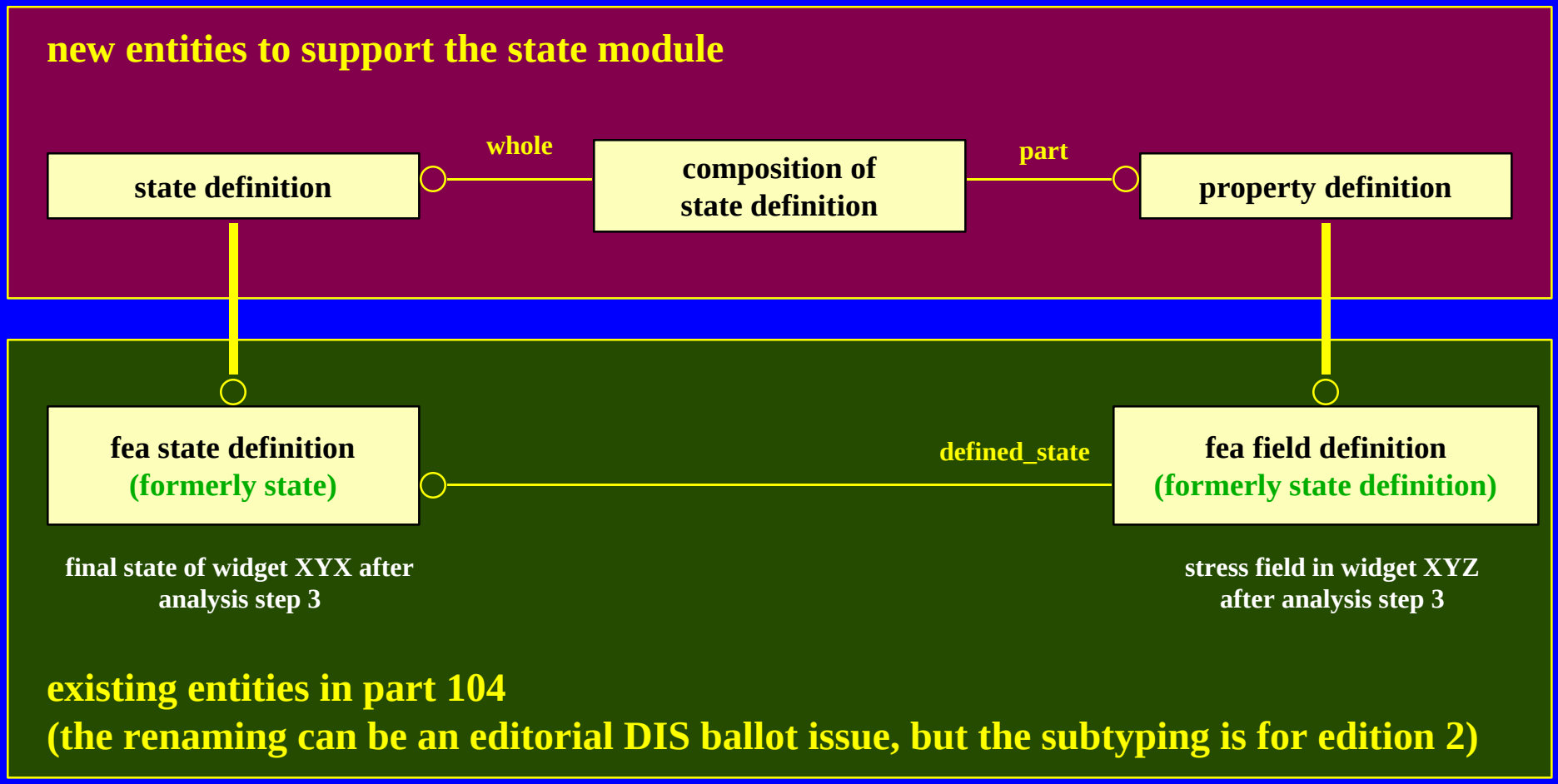
Interface to part 104/AP 209



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Adding probability

'Widget type XYZ has a 99.5% probability of a compressive yield strength greater than 510 MPa'

- **Widget type XYZ is a class (or set) of physical objects**
- **There is a 99.5% probability that a member of widget type XYZ selected at random is also be a member of the class (or set) of all physical objects with a F_{cy} greater than 510 MPa**

As before, we need to know when the statement is true

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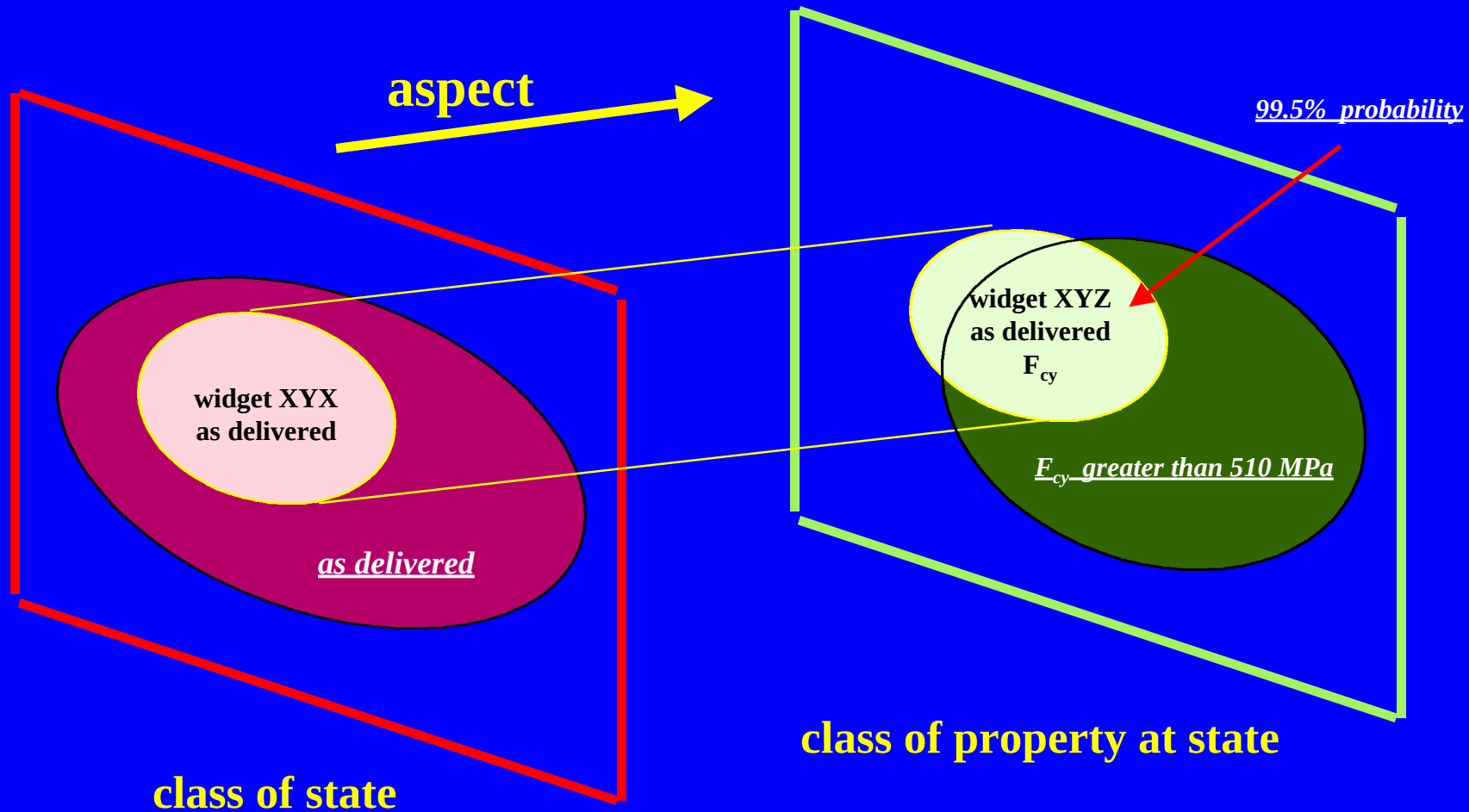
Precise semantics for probability



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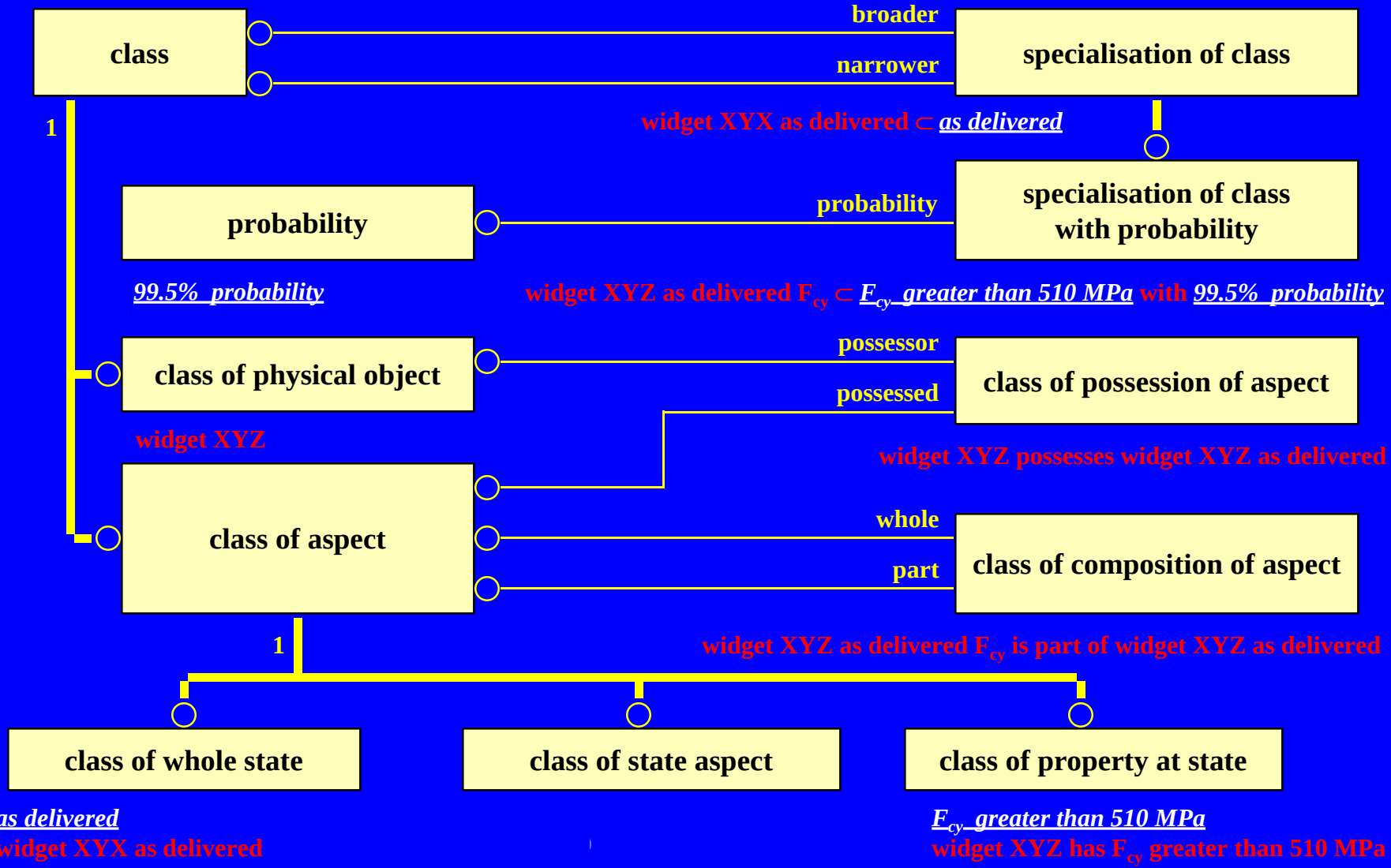
Conceptual model for probability



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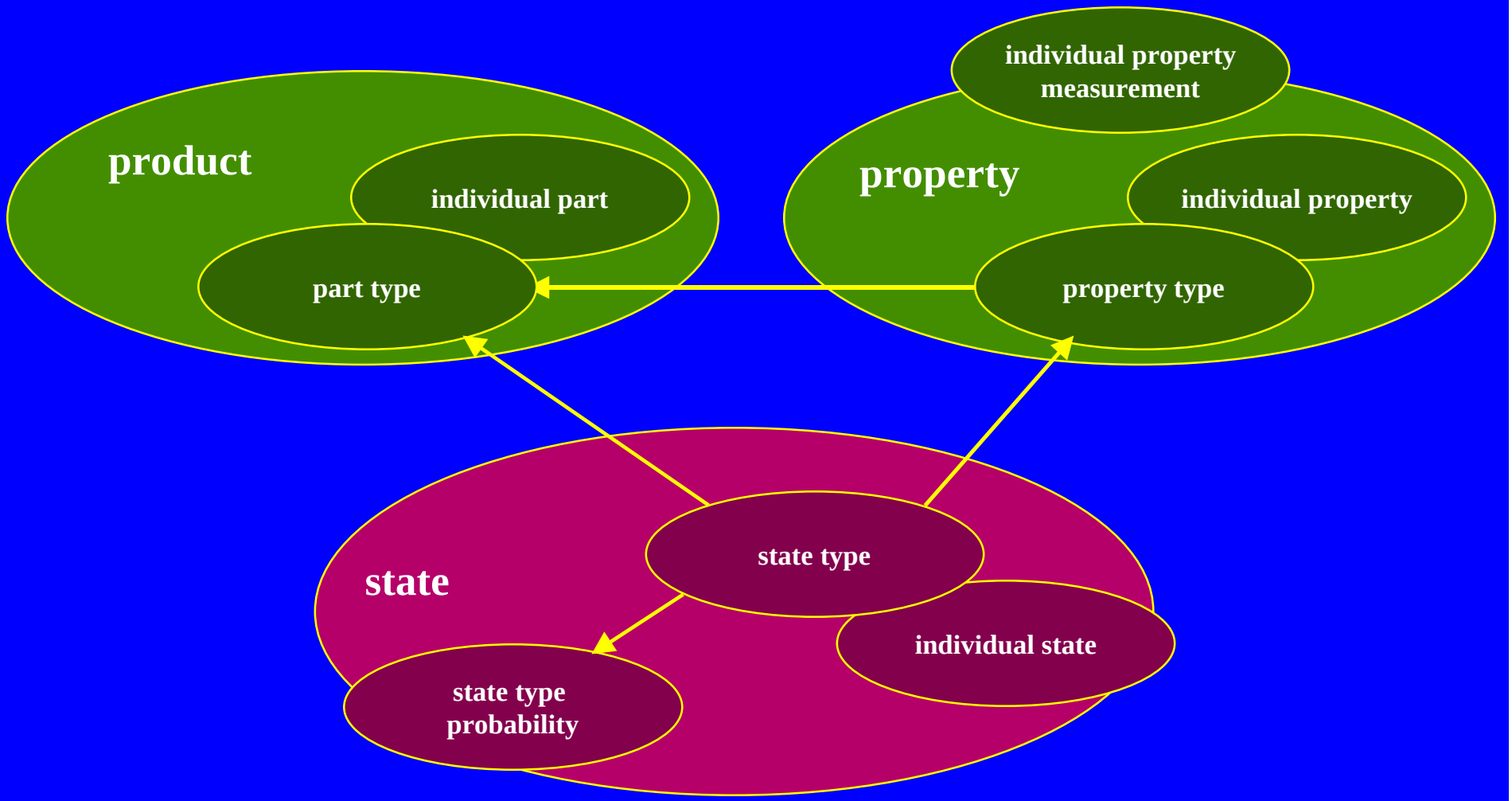
Sub-modules



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Conclusions

- There is a clear distinction between a part type (a class/set) and individual part the module ARM
  - » Part type and individual part modules are needed
  - » Property type and individual property modules are needed
- The introduction of state (outside FEA) requires minor additions to the IRs, but no changes - it is upwardly compatible
- Part 104 entities for state are subtypes of the IR additions
  - » Minor editorial changes to the part 104 DIS will aid upward compatibility

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Next steps

- **Initial work has concentrated on:**
  - » **design specifications;**
  - » **analysis predictions;**
  - » **predictions based upon reduced test data**
- **Next steps will add:**
  - » **properties of individual parts**
  - » **measurement process**
  - » **information about the sample and the data reduction process**